TEXTILE MUSEUM JOURNAL

Decorative Tapestry. Alexander the Great Hunting. Egypt, 8th to 9th century (?) T.M. 11.18

Volume I—Number 1

NOVEMBER 1962

CONTENTS

NOTES AND COMMENTS 1

A COPTIC TAPESTRY OF BYZANTINE STYLE. *Rudolf Berliner* 3

PHOTOGRAPHING TEXTILES FOR A MUSEUM. *Osmund Leonard Varela* 23

GIFTS FROM KASHAN TO CAIRO. *Charles Grant Ellis* 33

PRINCIPLES OF TEXTILE CONSERVATION SCIENCE, NO. I.
General Chemical and Physical Structural Features of the Natural Textile Fibers. *James W. Rice* 47

PRINCIPLES OF TEXTILE CONSERVATION SCIENCE, NO. II.
Practical Control of Fungi and Bacteria in Fabric Specimens. *James W. Rice* 52

CONSERVATION NOTES—A SPECIALIZED VACUUM DEVICE FOR FRAGILE TEXTILES. *Joseph Vincent Columbus* 56

NOTES ON THE AUTHORS Inside back cover

TRUSTEES AND STAFF LISTING Outside back cover

Published annually. Copyright 1962 by The Textile Museum, 2320 S Street, Northwest,

Washington 8, D. C. Printed by Graphic Arts Press, Inc. Subscription $2 a year.

PRINCIPLES OF TEXTILE CONSERVATION SCIENCE NO. II

PRACTICAL CONTROL OF FUNGI AND BACTERIA IN FABRIC SPECIMENS

JAMES W. RICE

In cleaning some of our ancient fabrics and textiles for exhibition we have noted occasional rinse water samples that have developed signs of both fungi and bacterial growths, when the water stood for a while.

Whether contamination was present when the textiles were found cannot be established, since almost without exception they arrive at the museum with little or no history. One must assume, therefore, that damaging effects may be present. For this reason, the Textile Museum Conservation Laboratory has undertaken a study of practical control because we believe that one of the most serious degradation effects on textile fibers is probably the development of fungi such as mildew. These are minute plant- or yeast-like organisms that are seeded from microscopic spores carried by air, water or transplanted by contact. As these miniature plants grow, they are sustained by organic matter composing the fiber and, in doing so, destroy its chemical or physical structure. The results can be recognized as embrittlement and when the fibers are magnified about 150 to 300 diameters in transmitted light, as short fragments of fibrils and frayed or split ends of the fibers.[1] Other distinctive results are changes in color to white, grey, green, or black, noticeable odors from mustiness to disgustingly putrid and a definite loss of fiber and fabric strength.

There are many different types of these fungi, each of which may produce a particular color, odor, or physical change effect. Some, especially the simpler organic species that may be actually bacteria, flourish in absence of air and oxygen and are called anaerobic. Others requiring oxygen are aerobic. For best growth, moisture ranging from saturated air to complete immersion and moderately warm temperatures are required.

There are several ways of destroying or arresting such fungus growths. A widely used treatment developed for preservation of military fabrics consists of impregnating the materials with fungicides. These are toxic chemicals which poison the fungi. Such substances as organic copper and mercury compounds, complex phenols and similar solutions are widely used but are likely to cause objectionable stains and discolorations. These chemicals are also quite toxic to human beings. Phenol or carbolic acid and bleaches have been used successfully as household remedies for mildewed fabrics and rugs for many years. The latter do not confer permanent protection however, whereas the more recent organo-mercury and copper compounds do. Exposure to sunlight especially on a warm day is also effective but any of these popular treatments may be damaging to fragile materials and dyes.

Sterilization by heat is an approved method of killing bacteria and spores but there are some species that will withstand temperatures well above the boiling point of water. This might damage some very fragile specimens. Equipment and facilities for heat sterilization are relatively expensive and bulky.

Gaseous sterilization has become increasingly more widely used in recent years. Of several possible vaporous disinfective substances ethylene oxide is considered best from many points of view for textile conservation purposes. For more than twenty years it has been used to kill weevils and beetles in flour mills, spice packing plants, and grain elevators. More recently, it has been recommended as a way of destroying

"hard to kill" fungi and spores like mildew, and perhaps even anthrax and bacteria such as staphylococci. The evidence points to a possible way of arresting damage by organisms and insects in fibers and fabrics, and we have been experimenting with it as a treatment for possibly infected specimens.

Ethylene oxide alone is both toxic and explosive. For that reason it is generally used in autoclaves or specially constructed gas chambers embodying many safety features. To decrease the explosion hazards, it is often mixed with non-explosive gases such as carbon dioxide or Freons (flourine-carbon compounds similar to modern refrigerants which are non-explosive low boiling liquids.)[3]

One effective commercial mixture is "Carboxide"[2] a trade named product which consists of 90% carbon dioxide and 10% ethylene oxide. It is slightly toxic but non-explosive. Since it is under pressure, it requires a strong container and generator system, an autoclave and pressure piping and for that reason we have not used it in our work.

A patented Freon—89%, ethylene oxide—11% mixture is available under the trade name "Cryoxcide."[3] This is considered as very much safer than "Carboxide" in that it is easier to handle, is non-explosive and of relatively low toxicity. It can be purchased in 20 oz. pressure type cans.[4] In our work, we have used these cans for repeated small applications by attaching a small puncturing valve with copper tubing connections to the top.[5]

Those of us who handle old fabrics and who want to insure their protection both from the point of view of possible dormant contamination already in the sample or from exposure to current infestation after we receive it may choose either a temporary or a permanent type of sterilization procedure, both of which have been investigated in this Laboratory.

FIELD PROCEDURES FOR PROTECTING SPECIMENS

Sterilization may be accomplished in the field with a minimum of equipment and supplies. For this, we have used polyethylene tubing a little heavier than that commonly employed for encasing garments after drycleaning, as a packaging and improvised gas chamber space. It is also a method of treating rugs and very large tapestries. Perhaps the simplest way to form a seal in the end of the tubular material is to twist the end very tightly for about a foot of length. Then double this over and tie it securely with cord or fine wire. The fabric sample is then carefully placed inside the bag and enough of the tubing measured off to contain the rolled or folded fabric or specimen plus about three feet more. The tubing is cut at this point and a can of "Cryoxcide" to which one of the "Can-O-Gas" valves has been attached, is placed inside. The excess air is then expelled from the tubing by flattening it gently. Again about one foot of the end of the tube is twisted, doubled over and tied.

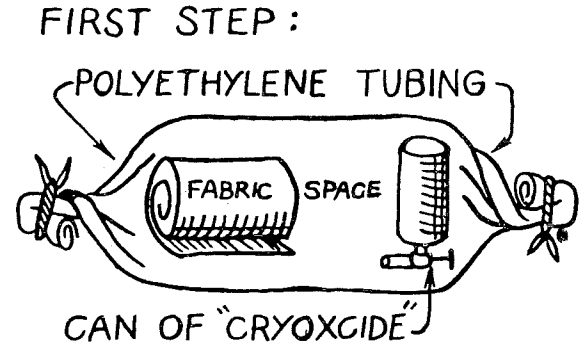
The "Cryoxcide" can is then grasped through the plastic bag, held upside down and the valve opened. This will force some of the liquid into the space. While the "Cryoxcide" mixture is not expected to damage any of the materials, it is best to direct the stream of liquid toward a tube wall since the Freon might dissolve some glues, paints or varnishes if it comes in direct contact. The liquid evaporates quite rapidly and is not likely to affect the sample in the vapor phase.

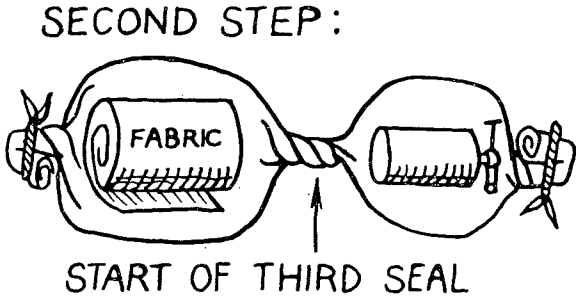
The "Can-O-Gas" valve should be closed through the tube wall as soon as enough vapor has been released to form a globular balloon at the end of the bag where the specimen has been placed. The gas should be pressed toward this end, the bag compressed and the tube twisted near the end of the fabric. The seal beyond the can of "Cryoxcide" should then be opened and the can removed. The middle seal should then be doubled over and tied.

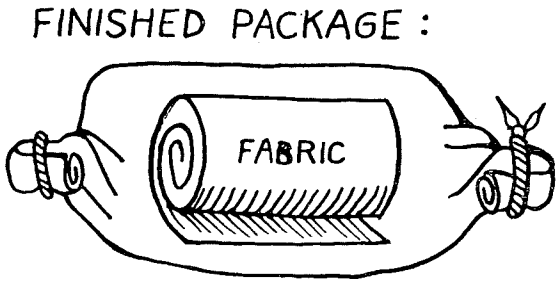
The sample in the ballooned bag is then set aside for about 24 hours in which the sterilization is expected to be accomplished. The ethylene oxide will slowly pass through the polyethylene wall but air or water vapor will not enter so that the package will gradually flatten but protection from contamination continues as long as the bag wall is not punctured. This will permit shipment and storage even under unfavorable outside

atmospheric conditions. Should there be a question as to whether the package will withstand shipping, it may be protected by additional layers of the tubing.

The following drawings illustrate fumigation methods in the field with "Cryoxcide."



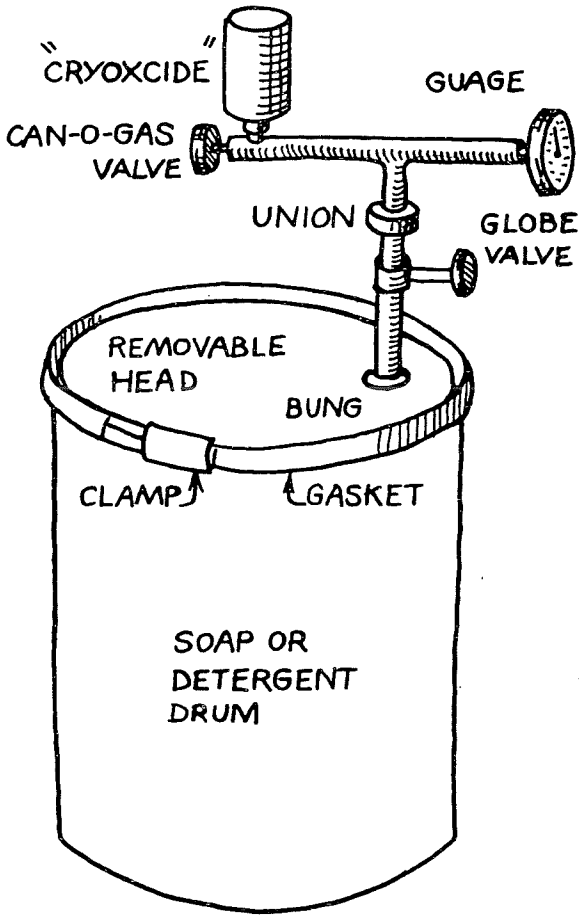




EQUIPMENT FOR STERILIZING FRAGILE MATERIALS AND OBJECTS AT A PERMANENT INSTALLATION

Another way of providing an improvised fumigating chamber using "Cryoxcide" and suitable for sterilizing fragile specimens and objects that should not be handled was suggested by a portable hospital ward type apparatus developed by the National Institute of Health, Bethesda, Maryland.

For our Laboratory we used a conventional type metal 55 gallon size shipping drum with a removable head and lever lock fastener. A screw bung in the head was drilled and threaded to receive a one-eighth inch pipe fitted with a globe valve, tubing and unions to connect with a "Can-O-Gas" valve. A length of 7/16 inch rubber tubing was cut to form a gasket and fit the annular recess in the drum head. This was glued in place. This gasket and the fittings should be able to withstand about 5 to 7 psi gauge pressure when the drum head is fastened down. The following drawing illustrates an improvised Sterilization Chamber.



In use, the articles or fabric specimens are placed inside of plastic bags which may be sealed by an electric heat line sealing machine.

If the bags or envelopes are sealed at both ends before fumigation, the tubing walls should be one or no more than two mils thick, otherwise the ethylene oxide may not penetrate. If heavier tubing is used, one end of the bag should be left open until after treatment. Before removal from the chamber, the open end bags may be closed by folding and sealing immediately. Handling, of course, should be done with rubber gloves which have been previously sterilized and allowed to air for a time to get rid of any absorbed ethylene oxide. This is to avoid skin effects.

Time of exposure in the chamber under 5 psi pressure is about 24 hours or more. Longer treatments are necessary for sealed packages.

A 20 ounce can of "Cryoxcide" of 11% ethylene oxide will produce a concentration of about 300 mg/l in the 55 gallon space of our shipping drum and a 100% kill of spores on 24 hours' exposure at 70° F. or above may be expected. In case of doubt, longer exposure may be advisable. For proof of effectiveness we have "Killit No. 1" [6] spore strips which are paper strips impregnated with a resistant bacteria culture as indicators. These "spore strips" are placed within the chamber when the treatment is begun. When the chamber is opened the strips are carefully transferred to sterile, distilled water and incubated at 55 to 65° C. (130° to 150° F. approximately) for 24 to 48 hours. A change in the color of the water from purple to turbid yellow would indicate lack of effectiveness of the treatment.

The same fumigation treatments are also excellent protection from insects as both adults and eggs are destroyed and, as long as the treated samples remain undisturbed in closed plastic bags, we may expect no further damaging attacks.

We believe that this system of fumigation is relatively safe, inexpensive, simple to do and requires a minimum of equipment and supplies and for that reason will be helpful in preserving in the field and in storage until permanent preservation, repair and mounting can be accomplished.

NOTES

1. See idealized illustration under discussion of fibrils, paragraph 6, Principles of Textile Conservation Science, Paper No. 1.

2. "Carboxide" 90% carbon dioxide and 10% ethylene oxide is marketed by Union Carbide and Carbon Chemicals Co. A similar product known as a sterilizing mixture is put out by the Mathieson Company, Inc.

3. "Cryoxcide" is a registered trade mark of the American Sterilizer Co. of Erie, Pa. for 11% ethylene oxide 44.5% dichlorodifluoromethane, and 44.5% trichloromonofluoromethane (one of a series of "Freons"—trade named products of the E. I. DuPont de Nemours Company). Other sterilizing gases resembling "Cryoxcide" are "Steroxcide", a product of the Wilmot Castle Co., Rochester, N. Y., and "Benvicide" licensed by Bienvenue Laboratories and sold by Mathieson Co., Inc.

4. Pressure type cans are made and filled by the Pennsylvania Engineering Co., Philadelphia, Pa.

5. "Can-O-Gas" valves are manufactured by Virginia Smelting Co., West Norfolk, Va. Similar valves are made by the Superior Valve and Fitting Co., Pittsburgh, Pa.

6. "Killit" spore strips #1 may be obtained from the Baltimore Biological Laboratories, Baltimore 18, Md.

BIBLIOGRAPHY

1. Gaseous Sterilization with Ethylene Oxide by R. S. Lloyd and E. L. Thompson. American Sterilizer Co., Erie, Pa.

2. Simple Improvised Chambers for Gas Sterilization with Ethylene Oxide by Donald G. Schley, Robert L. Koffman, and Charles L. Phillips. Army Chemical Corps, Fort Detrick, Maryland.

3. Interview with Dr. L. T. Herman, Acting Chief of Sanitation Section, Environmental Services Branch, Division of Research Services, National Institutes of Health, Bethesda, Maryland.